Multiple choice questions - Vector spaces and linear maps

Year: University Year 1 · 10

Question 1 Which is a subspace of $\mathbb{R}^2$?

- ◯ **A.** $\{(x, y) : x \geq 0\}$
- ◯ **B.** $\{(x, y) : y = 2x\}$
- ◯ **C.** $\{(x, y) : y = 2x + 1\}$
- ◯ **D.** $\{(x, y) : xy = 0\}$

Question 2 $\dim \mathbb{R}^4 =$

- ◯ **A.** 3
- ◯ **B.** 4
- ◯ **C.** 5
- ◯ **D.** infinite

Question 3 Three vectors in $\mathbb{R}^2$ are

- ◯ **A.** always independent
- ◯ **B.** always dependent
- ◯ **C.** a basis
- ◯ **D.** orthogonal

Question 4 Rank-nullity: for $T : \mathbb{R}^5 \to \mathbb{R}^3$ of rank 3, the nullity is

- ◯ **A.** 0
- ◯ **B.** 2
- ◯ **C.** 3
- ◯ **D.** 5

Question 5 T is injective iff

- ◯ **A.** $\ker T = \{0\}$
- ◯ **B.** $\operatorname{im} T = W$
- ◯ **C.** $\det T = 1$
- ◯ **D.** $T = 0$

Question 6 The span of $(1, 0, 0)$ and $(0, 1, 0)$ is

- ◯ **A.** a line
- ◯ **B.** the xy-plane
- ◯ **C.** $\mathbb{R}^3$

- ◯ **D.** a point

Question 7 $\dim P_2 =$

- ◯ **A.** 2
- ◯ **B.** 3
- ◯ **C.** 4
- ◯ **D.** 1

Question 8 If A is 3×3 with $\det A \neq 0$, its columns are

- ◯ **A.** dependent
- ◯ **B.** independent
- ◯ **C.** zero
- ◯ **D.** equal

Question 9 The matrix of $T(x, y) = (3x,\ x + y)$ is

- ◯ **A.** $\begin{pmatrix} 3 & 0 \\ 1 & 1 \end{pmatrix}$
- ◯ **B.** $\begin{pmatrix} 3 & 1 \\ 0 & 1 \end{pmatrix}$
- ◯ **C.** $\begin{pmatrix} 1 & 1 \\ 3 & 0 \end{pmatrix}$
- ◯ **D.** $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$

Question 10 A linear map must send the zero vector to

- ◯ **A.** itself (zero)
- ◯ **B.** the identity
- ◯ **C.** any vector
- ◯ **D.** a basis

Answer grid - Vector spaces and linear maps

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Question	Answer	Explanation
1	**B**	A line through the origin.
2	**B**	Four basis vectors.
3	**B**	More vectors than the dimension.
4	**B**	$5 - 3$.
5	**A**	Trivial kernel.
6	**B**	Two independent vectors.
7	**B**	Basis $1, x, x^2$.
8	**B**	Invertible matrix.
9	**A**	Rows from the output components.
10	**A**	$T(\mathbf{0}) = T(0\mathbf{v}) = 0\,T\mathbf{v} = \mathbf{0}$.